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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/748,565

12/30/2003

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11/02/2005

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EXAMINER

MATISIAK, JENNIFER E

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 11/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/748,565

Applicant(s)

WHITE ET AL.

Examiner

Jennifer Matisiak

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10/11/05.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 5/3/04, 10/10/05, 12/30/03
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. Applicant's election without traverse of Group I in the reply filed on September 9, 2005 is acknowledged.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 18-21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

1. Regarding claim 18, the phrase "for example" renders the claim indefinite because it is unclear whether the limitation(s) following the phrase are part of the claimed invention. See MPEP § 2173.05(d).
2. Claims 19-21 recite the limitation "the organic moieties" in reference to claim 17. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 1 and 2 are rejected under 35 U.S.C. 102(e) as being anticipated by Searls et al. (US 6,865,016), hereinafter Searls.

Regarding claim 1, Fig. 2 of Searls shows an integrated circuit package, comprising a die (12); a heat sink (24); and a thermal intermediate structure (26) comprising a plurality of carbon nanotubes (28), some of which are tethered to at least one of the die and the heat sink.

Regarding claim 2, Searls teaches a heat sink having a metal coating (col 1 lines 60-65, col 2 lines 65-67).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Wang et al. (US 2004/0164390).

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Regarding claim 3, the difference between Searls and the claimed invention is "wherein the metal coating is gold." Fig 7 of Wang shows a heat sink (270) coated with gold [par 0031]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by coating the heat sink with gold in order to facilitate the adhesion of organic moieties to heat sink.

2. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Wang and in further view of Yamazaki.

Regarding claims 4 and 5, the difference between Searls and the claimed invention is "wherein at least one end of some of the carbon nanotubes have organic moieties attached; wherein the organic moieties include an amide linker chemically bonded to the end of some of the carbon nanotubes of the plurality of carbon nanotubes." Fig. 7 of Yamazaki shows an adhesive strip (13) of amide resin (col 7, line 57) used to attach chip (2) to carrier (3). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls to include an amide linker in order to tether the carbon nanotubes to at least one of the die and heat sink.

3. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Wang and Yamazaki and further in view of Lieber et al. (US 2002/0117659).

Regarding claim 6, the difference between Searls and the instant invention is "the package of claim 4, wherein the organic moieties include an amide linker chemically bonded to the end of some of the plurality of carbon nanotubes and a thiol based linker to link to the surface of at least one of the die and heat sink." As aforementioned, Wang and Yamazaki teach the limitations of claim 4.

Additionally, Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Searls by including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

4. Claims 7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Lieber et al (US 2002/0117659), hereinafter Lieber.

Regarding claim 7, the difference between Searls and the instant invention is "some nanotubes of which have organic moieties attached to one end thereof, the one end of some nanotubes chemically bonded to the heat sink; and a second thermal intermediate portion comprising a plurality of carbon nanotubes, some nanotubes of which have organic moieties attached to one end thereof, the one end of some nanotubes chemically bonded to the die."

Regarding claim 9, the difference between Searls and the instant invention is "the package of claim 7, wherein the organic moieties of the first intermediate

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portion and the organic moieties of the second intermediate layer include thiol linkers." Fig. 1a of Lieber teaches thiol linkers attached to a gold surface [par 0130] of a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by including organic moieties comprised of amide linkers in order to attach the carbon nanotubes to the surface of the heat sink.

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Yamazaki. Regarding claim 8, the difference between Searls and the instant invention is "wherein the first and second thermal intermediate portions of the intermediate layer include amide linkers." Fig. 7 of Yamazaki shows an adhesive strip (13) of amide resin (col 7, line 57) used to attach chip (2) to carrier (3). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls to include an amide linker within a polymer in order to tether the carbon nanotubes to at least one of the die and heat sink.

6. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Yamazaki and further in view of Lieber.

Regarding claim 10, the difference between Searls and the instant invention is "the package of claim 7, wherein the organic moieties of the first intermediate portion and the organic moieties of the second intermediate portion include thiol linkers and amide linkers." Lieber teaches thiol linkers while

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Yamazaki teaches amide linkers as means of chemically tethering carbon nanotubes to a package. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls such that both thiol and amide linkers are employed in order to chemically tether the carbon nanotubes to both the die and heat sink.

Regarding claim 11, the difference between Searls and the instant invention is "the package of claim 10, wherein the carbon nanotubes of the thermal intermediate portions are generally perpendicular to a surface of the die or the surface of the heat sink." Yamazaki and Lieber teach the limitations of claim 10. Fig. 3 of Searls shows carbon nanotubes (38) of the thermal intermediate portions (26) as being perpendicular to the surface of the die (12) and the surface of the heat sink (16).

7. Claims 12 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Lieber. Regarding claim 12, the difference between Searls and the instant invention is "some nanotubes of which have organic moieties attached to one end thereof to tether the interface structure to a surface of at least one of a heat sink and an electronic circuit die." Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10).). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Searls by including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to

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link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

Regarding claim 22, the difference between Searls and the claimed invention is "treating at least one end of at least some of a plurality of carbon nanotubes by applying organic moieties thereto." Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10).). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Searls by including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

8. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Lieber, in further view of Wang. Regarding claim 13, the difference between Searls and the claimed invention is "the structure of claim 12, wherein the surface comprises a gold coating." As aforementioned, Lieber teaches the limitations of claim 12. Fig 7 of Wang shows a heat sink (270) coated with gold [par 0031]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by coating the heat sink with gold in order to facilitate the adhesion of organic moieties to heat sink.

Regarding claim 14, the basis for the rejection of claim 9 is the same basis for the rejection of this claim.

9. Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Searls in view of Lieber, further in view of Wang, and in further view of Yamazaki.

Regarding claim 15, the difference between Searls and the instant invention is "the thermal interface structure of claim 13, wherein the organic moieties comprise amide linkers." Fig. 7 of Yamazaki shows an adhesive strip (13) of amide resin (col 7, line 57) used to attach chip (2) to carrier (3). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls to include an amide linker in order to tether the carbon nanotubes to at least one of the die and heat sink.

Regarding claim 16, the difference between Searls and the instant invention is "the thermal interface structure of claim 13, wherein the organic moieties comprise thiol and amide linkers." Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Searls by including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

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10. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over of Millik, (US 2005/0093120), hereinafter Millik, in view of Searls.

Regarding claim 17, Fig. 2b of Millik shows a computing system comprising one dynamic random access memory device (510 of Fig. 5); a die having a circuit (202 and 210) thereon to couple to the memory device; a heat sink (116). The difference between Millik and the instant invention is "a thermal intermediate structure comprising a plurality of carbon nanotubes, some of which are tethered to at least one of the die and the heat sink." As aforementioned, Searls teaches this difference. It would have been obvious to one of ordinary skill in the art at the time invention was made to modify the invention of Millik by including a computing system comprising a dynamic random access memory device; a die including a circuit coupled to the memory device; a heat sink in order to have a fully operational computing system that utilizes the heat dissipation capabilities of carbon nanotubes.

Regarding claim 18, Fig. 2b of Millik shows a processor (202) that acts upon data signals.

11. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Millik, in view of Searls, in further in view of Yamazaki. The difference between Millik and the instant invention is "the system of claim 17, wherein the organic moieties comprise amide linkers." As aforementioned, Millik and Searls teach the limitations of claim 17. Fig. 7 of Yamazaki shows an adhesive strip (13) of amide

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resin (col 7, line 57) used to attach chip (2) to carrier (3). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls to include an amide linker in order to tether the carbon nanotubes to at least one of the die and heat sink.

12. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Millik, in view of Searls, in further in view of Lieber. The difference between Millik and the instant invention is "the system of claim 17, wherein the organic moieties comprise thiol linkers." Millik and Searls teach the limitations of claim 17.

Furthermore, Fig. 1a of Lieber teaches thiol linkers attached to a gold surface [par 0130] of a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by including amide linkers in order to attach the carbon nanotubes to the surface of the heat sink.

13. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Millik, in view of Searls, in further in view of Lieber, in further view of Yamazaki. The difference between Millik and the instant invention is "the system of claim 17, wherein the organic moieties comprise thiol linkers." As aforementioned, Millik, Wang and Yamazaki teach the limitations of claim 17. Additionally, Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Searls by

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including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

14. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Lieber, in further in view of Wang. The difference between Searls and the instant invention is "the process of claim 22, wherein the metal is selected from the group consisting of gold and gold alloys." Fig 7 of Wang shows a heat sink (270) coated with gold [par 0031]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by coating the heat sink with gold in order to facilitate the adhesion of organic moieties to heat sink.

15. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Lieber, in further view of Wang and in further view of Yamazaki. The difference between Searls and the instant invention is "the process of claim 22, wherein the treating the at least one end of some of the plurality of nanotubes comprises forming an amide based linkage and a thiol based linkage thereon." As aforementioned, Wang and Yamazaki teach the limitations of claim 22. Additionally, Lieber teaches the use of a thiol-based linker [par 0130] as a means to attach carbon nanotubes (38 of Fig. 1a) to a die (10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

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modify Searls by including amide linkers bonded to some of the plurality of nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink. In this manner, the carbon nanotubes can be attached to at least one of the heat sink and die.

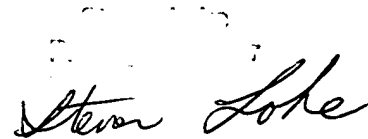
16. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Searls, in view of Lieber, in further in view of Wang, in further view of Yamazaki. The difference between Searls and the instant invention is "the process of claim 22, wherein the treating the at least one end of some of the plurality of nanotubes comprises forming an amide based linkage thereon." Fig 7 of Wang shows a heat sink (270) coated with gold [par 0031]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Searls by coating the heat sink with gold in order to facilitate the adhesion of organic moieties to heat sink.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer E. Matisiak whose telephone number is 571-272-2639. The examiner can normally be reached on Business Days 9:30a-6:30p EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 517-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Steven Loh". The signature is written in a cursive, flowing style. Above the signature, there is a faint, circular stamp or seal, but its details are not clearly legible.